(54) Title: CONNECTING DEVICE AND METHOD OF CONNECTION
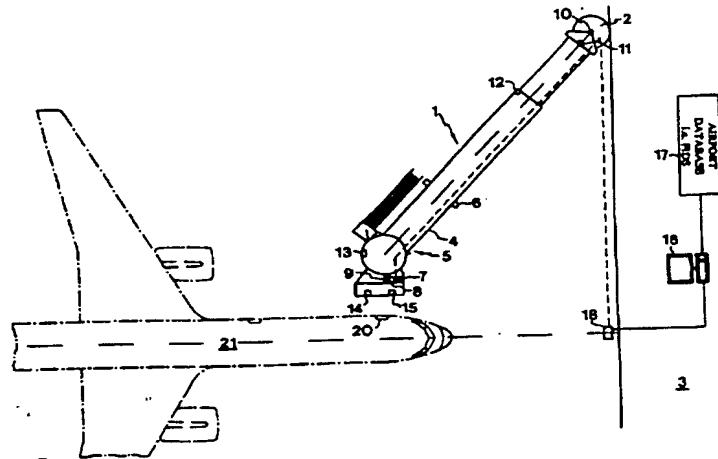
(57) Abstract

One end of a passenger bridge (1) or a goods-handling device of mobile type can be expediently and securely connected to a door (20) on a craft (21), especially an aircraft, by determining the position of the door in relation to a reference point on the craft and storing it in a computer system. Furthermore, the absolute position of the door when the craft has come to a halt and the passenger bridge or the goods-handling device is to be connected, is determined by measuring the distance from a reference point (18) on the ground to the craft. Finally, the computer system (7, 16) guides the passenger bridge to the door of the craft, the position of the end of the passenger bridge or the goods-handling device being determined during the guiding operation and inputted into the computer system. To further shorten the connection time, the passenger bridge or the goods-handling device is advantageously guided to an initial position of connection in the vicinity of the craft, in which position the end of the passenger bridge or the goods-handling device is aligned with the expected position of the door and disposed at a small distance therefrom, before the craft has come to a halt.

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CONNECTING DEVICE AND METHOD OF CONNECTION

This invention relates to a connecting device and
a method of connecting one end of a passenger bridge or
a goods-handling device of mobile type to a door on a
craft, in particular an aircraft.

5   As a rule, modern airports are equipped with pas-
senger bridges on which the passengers may walk safely
between the terminal building and the aircraft, while
being sheltered from the rain and the wind.

A known mobile-type passenger bridge going under

10   the name of Apron Drive comprises a rotunda that is con-
nected to a terminal building and is rotatably mounted on
a column anchored in the ground. From the rotunda extends
a passageway, which is made up of a number of telescoping
elements, enabling variation of the length of the passage-

15   way. At the end of the passageway located farthest away
from the rotunda, there is provided a cabin which is
pivotable in relation to the passageway. The passageway
element to which the cabin is attached is suspended from
a vertically adjustable frame, which in turn is supported

20   by a bogie with wheels that can be driven separately.

The passenger bridge normally occupies a parking
position in the vicinity of the place where the aircraft
is to come to a halt after landing. When the aircraft has
come to a halt, an operator controls the passenger bridge

25   vertically and angularly, pivots the cabin and telescopi-
cally extends the passageway in the direction of the air-
craft, such that the end of the bridge is connected to
the door of the aircraft. The operation in the horizontal
plane is achieved by altering the speeds of the bogie

30   wheels in relation to one another.

Owing to its complexity, this operation requires
operators with special training, which of course is
expensive for the airlines. Furthermore, it takes a long
time to perform the connection. Also, it happens that the

35   bridges bump into the aircraft as a result of mismanoeu-

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vring on the part of the operator, thus damaging the air-
craft.

The object of this invention is, therefore, to solve
the problems described above.

5   According to the invention, this object is achieved
by a method as claimed in appended claim 1 and a device
as claimed in appended claim 8.

To be more specific, the solution to these problems
consists in determining the position of the door of the
10   aircraft with respect to a reference point on the air-
craft, and storing in a computer system information
related to the position of the door. Furthermore, the
position of the aircraft when this has come to a halt
and the passenger bridge is to be connected is determin-
15   ed, and information related to the position of the air-
craft is inputted into the computer system. As a result,
the computer system may determine the absolute position
of the door when the aircraft has come to a halt. Final-
ly, the passenger bridge is automatically guided to the
20   door on the basis of the information found in the compu-
ter system. During this guiding operation, the position
of the end of the passenger bridge is determined and
inputted into the computer system, such that the computer
system will know where the passenger bridge is located.

25   Thus, this connection of the passenger bridge does
not require any operator at all. Since the computer sys-
tem controlling the passenger bridge knows the exact
position of both the door and the end of the passenger
bridge and since there is thus no need of any assessment
30   by eye, the computer system is able to perform the con-
nection much more expediently and accurately than could
a human operator, there being in addition no risk of any
damage caused to the aircraft.

Moreover, this method of connection of the passenger
35   bridge is advantageous in that it enables the use of the
well-tried systems already arranged in many airports to
determine the position of aircraft, such that no new mea-

suring equipment need be installed to determine the posi-
tion of the aircraft door.

Such a per-se known system for determining the posi-
tion of an aircraft is based on the measurement of the
5   distance from a reference point to at least one point on
the aircraft with the aid of electromagnetic waves.

The time it takes to connect the passenger bridge
can be further shortened by guiding, even before the air-
craft has come to a halt, the passenger bridge to an ini-
10 tial position of connection, where only minimum operation
of the passenger bridge is required to connect it to the
door of the aircraft, but which nevertheless is so locat-
ed that there is no risk of the aircraft running into the
passenger bridge. If the expected position of the air-
15 craft when this will have come to a halt is stored in the
computer system, the expected position of the door when
the aircraft will have come to a halt can then be calcu-
lated. The passenger bridge can then be so aligned with
the expected position of the door that the end of the
20 bridge need only be telescopically extended a small dis-
tance in the direction of the door, provided that the
aircraft really does come to a halt in the expected posi-
tion.

To enable the connecting operation according to the
25 invention to be performed with many different models of
aircraft, or optionally for several doors of one and the
same aircraft, each door position is stored in the com-
puter system along with the identity of the aircraft, for
instance the designation of the model.

30 In order to obviate the risk of an aircraft being
damaged as a result of the computer system using the door
position of another aircraft model than the one actually
approaching the stand where a passenger bridge is to be
connected, the identity of the aircraft is checked, for
35 instance when the position of the aircraft is determined.

Accordingly, the invention is applicable to the
connection of passenger bridges to aircraft. However,

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the invention is also applicable to the connection of
"bridges" for the handling of goods. Furthermore, the
invention is applicable to other craft than aircraft,
such as ships.

5   An embodiment of the invention will now be described
with reference to the accompanying drawings, in which
       Fig. 1 is a schematic top view of a passenger bridge
which is known per se but is equipped with a device
according to the invention and which occupies a parking
10   position;
       Fig. 2 is a schematic top view showing the passenger
bridge in Fig. 1 in an initial position of connection;
and
       Fig. 3 is a schematic view showing the passenger
15   bridge in Figs 1 and 2 when having been connected to
the door of an aircraft.
       The following example illustrates how the invention
is applied to a prior-art passenger bridge of the type
Apron Drive described in the introduction to this speci-
20   fication.
       Thus, the passenger bridge 1 shown in Fig. 1 com-
prises a rotunda 2, which is connected to a terminal
building 3 and from which extends a passageway 4. This
passageway 4, whose length can be varied by telescoping,
25   ends with a pivotable cabin 5.
       As mentioned by way of introduction, the passenger
bridge can be guided to different positions to be con-
nected to an aircraft. To this end, the passenger bridge
1 comprises a bogie with driving wheels that can be acted
30   upon with a view to achieving angular displacement of the
passenger bridge as well as telescoping of the passageway
elements to alter the length of the passenger bridge.
Furthermore, the passageway 4 is suspended from a frame
6, which can be used for adjusting the height of the pas-
35   senger bridge 1. Finally, the passenger bridge has means
which can be acted upon with a view to pivoting the cabin
5.

The passenger bridge shown in Fig. 1 is provided
with a device for automatic connection thereof to an air-
craft. This device comprises a local passenger-bridge
computer 7 having a control panel 8 arranged in the cabin
5. The local computer 7 is connected to, and adapted to
act upon, the means for positioning the passenger bridge,
to be more specific the means for adjusting the height of
the passenger bridge, for adjusting the length of the
passenger bridge by telescoping of the passageway ele-
ments, for pivoting the cabin 5 and for angularly dis-
placing the passenger bridge 1. The computer 7 further
comprises a database 9, in which is stored, inter alia,
information on the positions of the doors of all the air-
craft models in connection with which the invention is to
be used. Preferably, the door positions are stored as the
coordinates of the door centres in relation to a prede-
termined reference point on the aircraft, for instance a
point on the surface below or above the cockpit window.
Information on the expected stop position of the diffe-
rent aircraft models is also stored in the database 9.

To enable the local computer 7 to determine the cur-
rent position of the passenger bridge 1, this is equipped
with position-determining means which, in the illustrated
example, comprise an absolute-value transducer 10 arrang-
ed on the rotunda 2 to determine the angular position of
the passageway, an absolute-value transducer 11 arranged
on the rotunda 2 to measure the height of the passageway,
a pulse generator 12 adapted to determine the relative
positions of the passageway elements and, consequently,
the length of the passageway, as well as a pulse genera-
tor 13 adapted to determine the angular position of the
cabin 5. On the basis of the input signals obtained from
these transducers 10-13, the local computer 7 is able
to guide the passenger bridge to an optional position
amongst the positions the bridge may occupy. The trans-
ducers are of the type retaining its information also if
the current supply is interrupted.

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It goes without saying that the position-determining means indicated above are but examples, and that other sorts of transducers, as well as another number of transducers, may also be used. For instance, a laser may be mounted on the roof of the cabin, as may at least two reflectors on different locations on the terminal building. By sweeping the laser, measuring the distance to the reflectors with the aid of the laser, and determining the angular position of the laser when directed towards the reflectors, the position of the cabin may be determined.

In order to achieve safe and reliable connection of the passenger bridge to the door of the aircraft, the passenger bridge is further provided with an electromagnetic distance meter 14, which is disposed on the pivotable cabin 5 and is adapted to measure the distance to the aircraft as well as the height of the aircraft above ground. On that part of the cabin 5 which is to come into contact with the body of the aircraft, there are further provided one or more pressure transducers 15, which are adapted to measure the pressure exerted by the passenger bridge 1 on the body of the aircraft.

The local computer 7 is connected to a central computer 16, which may serve a plurality of stands at the airport. In the database 17 of the central computer 16, there is stored information about which aircraft are to arrive at the different stands. Among other things, this information includes the time of arrival, the airline, the model, the flight number and the place of departure of each aircraft.

With a view to determining the position of the aircraft when this has come to a halt at the stand and the passenger bridge 1 is to be connected, an electromagnetic distance meter 18 is further arranged on the outside of the terminal building 3 and aligned with the aircraft-stand centre line. The distance meter 18 may, for instance, be of the type described in SE 463,486 and is

connected to the local computer 7 via the central com-
puter.

Here follows a description of how the passenger
bridge 1 is connected to a door 20 on an aircraft 21
5 which comes to a halt and is parked at the stand 19
indicated in Fig. 1.

When an aircraft has landed, this fact is recorded
in the central computer 16, which in turn notifies the
local computer 7 in the passenger bridge 1 involved and
10 transmits information on the type of aircraft and its
registration number.

Upon receipt of this information, the local compu-
ter 7 activates the distance meter 18 and guides the pas-
senger bridge 1 to an initial position of connection for
15 the type of aircraft approaching the stand 19. The ini-
tial position of connection is determined on the basis of
the expected position of the aircraft when this has come
to halt at the stand 19, as well as the position of the
door on the aircraft, such that the end of the passenger
20 bridge that is to be connected to the aircraft will be
aligned with the expected position of this door and be
located at but a small distance therefrom in the initial
position of connection.

When the initial position of connection has been
25 determined, the local computer 7 first guides the pas-
senger bridge 1 to a correct angular position with the
aid of the signals obtained from the angle transducer 10.

On the basis of signals received from the pulse
generator 12, the local computer 7 then telescopically
30 extends the passageway elements, so as to give the pas-
sageway 4 the correct length.

Next, the local computer 7 adjusts the height of
the passenger bridge by acting upon the frame 6, the out-
put signals from the height transducer 11 being used for
35 detecting when the end of the passenger bridge is on a
level with the expected position of the door of the air-
craft.

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Finally, the local computer 7 pivots the cabin 5 with the aid of signals from the pulse generator 13, such that the end of the passenger bridge is located in a plane that is parallel to the plane of the expected
5   position of the door, whereupon the local computer 7 informs the central computer 16 that the passenger bridge has been preset, i.e. that it occupies the initial position of the connection.

In Fig. 2, the passenger bridge is shown when occu-
10   pying the initial position of connection, and the expected stop position of the aircraft 21 at the stand 19 is indicated by dash-dot lines.

With the aid of the distance meter 18, the local computer 7 monitors the arrival of the plane 21. The
15   distance meter 18, which for instance may have a range of 100 m, scans at a high frequency a sector located in front of the terminal building, such that the position of the aircraft can be determined with a high resolution when the aircraft comes within the measuring range of the
20   distance meter 18.

When the local computer 7 detects, with the aid of the signals obtained from the distance meter 18, that the aircraft 21 has come to a halt at the stand 19, it checks that the aircraft is of the type for which the initial
25   position of connection has been preset. This check can be carried out by determining the height of the aircraft with the aid of the distance meter, and comparing this height with the type of aircraft that, according to the local computer 7, has arrived at the stand. If this check
30   reveals that the real aircraft is of another type than the one indicated in the local computer, the connection is interrupted and an error signal is emitted.

Since the height of the aircraft above ground, and hence that of its door, may vary according to the freight
35   of the aircraft, the local computer 7 checks the height of the aircraft with the aid of information obtained from

the distance meter 18 and the distance meter 14 and, when
need be, adjusts the height of the passenger bridge 1.

Furthermore, the local computer 7 checks that the
aircraft 21 is correctly parked in depth, i.e. that the
5   distance between the distance meter 18 and the aircraft
is as expected. If this is not so, the computer 7 calcu-
lates a new angular position for the passenger bridge and
displaces the bridge angularly until the angular
transducer 10 indicates that the correct position has
10   been attained.

As a rule, it is enough to adjust the vertical posi-
tion and the angular position, but also the length of the
passenger bridge as well as the position of the cabin
may, of course, be adjusted when need be.
15   After these adjustments, if any, the end of the pas-
senger bridge is aligned with the door opening of the
aircraft. The computer 7 then guides the passenger bridge
in the direction of the aircraft by telescopic extension
of the passageway elements. When the distance meter 14
20   indicates that the distance to the aircraft is smaller
than a predetermined value, for instance 0.3 m, the speed
of the passenger bridge is reduced. When the pressure
transducer 15 detects that the passenger bridge has come
into contact with the body of the aircraft, the computer
25   stops the telescopic extension. The passenger bridge is
now connected to the door of the aircraft, as illustrated
in Fig. 3.

Furthermore, the pressure transducer 15 ensures that
the pressure exerted by the passenger bridge on the body
30   of the aircraft is not too high. When the transducer
detects that this pressure exceeds a predetermined limit
value, the computer 7 telescopes the passenger bridge a
small distance away from the aircraft, thereby reducing
the pressure.
35   When the passenger bridge is connected in conven-
tional fashion, i.e. manually, the connecting operation

takes approximately 3-5 min. With the method according to the invention, the connection can be carried out in 30 s.

Also the return of the passenger bridge to the parking position after the aircraft has left the stand is, of course, performed automatically with the aid of the local computer 7.

If so desired, one may arrange the programs of the local computer so that an airline representative should, for instance before the connection from the initial position of connection is begun, sanction, by pressing a key on the control panel 8 of the local computer, that there is no objection to the passenger bridge being connected to the aircraft.

Since the door positions of all types of aircraft are stored in the local computer of each passenger bridge, the passenger bridge can be connected automatically also when the central computer 16 is out of order, if only the current type of aircraft is inputted into the local computer 7, which can be done via the control panel 8.

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CLAIMS

1. A method of connecting one end of a passenger
5   bridge (1) or a goods-handling device of mobile type to
a door (20) on a craft (21), c h a r a c t e r i s e d   by
the steps of
         - determining the position of the door of the craft
with respect to a reference point on the craft, and stor-
10   ing information related to the position of the door in a
computer system,
         - determining the position of the craft when this
has come to a halt and the passenger bridge or the goods-
handling device is to be connected, and inputting infor-
15   mation related to the position of the craft into a com-
puter system, and
         - guiding automatically the passenger bridge or the
goods-handling device to the door with the aid of the
information inputted into the computer system, the posi-
20   tion of the end of the passenger bridge or the goods-
handling device being determined during the guiding ope-
ration and inputted into the computer system.
         2. A method as claimed in claim 1, c h a r a c -
t e r i s e d   in that the step of determining the posi-
25   tion of the craft comprises measuring the distance from
a reference point (18) to at least one point on the craft
with the aid of electromagnetic waves.
         3. A method as claimed in claim 1 or 2, c h a r -
a c t e r i s e d. by the additional steps of
30   - inputting into the computer system information
about the expected position of the craft when this will
have come to a halt and the passenger bridge or the
goods-handling device is to be connected, and
         - guiding automatically, before the craft has come
35   to a halt, the passenger bridge or the goods-handling
device to an initial position of connection in the vici-
nity of the expected position.

4. A method as claimed in claim 3, charac-
terised in that the expected position of the door
when the craft will have come to a halt is determined,
and that the guidance to the initial position of connec-
5   tion comprises the alignment of the passenger bridge or
the goods-handling device with the expected position of
the door.

5. A method as claimed in any one of the preceding
claims, wherein the position of the door of the craft is
10   stored in the computer system along with the identity of
the craft, characterised in that the identity
of the craft is checked before beginning the connection
from the initial position of connection.

6. A method as claimed in any one of the preceding
15   claims, characterised in that the connection
is monitored by detecting the pressure exerted on the
craft by the passenger bridge or the goods-handling
device.

7. A method as claimed in any one of the preceding
20   claims, characterised in that the craft is
an aircraft.

8. A device for connecting one end of a passenger
bridge (1) or a goods-handling device of mobile type to
a door (20) on a craft (21), said passenger bridge or
25   goods-handling device having positioning means for posi-
tioning said end, characterised by
- first position-determining means for determining
the position of the passenger bridge or the goods-handl-
ing device,
30   - second position-determining means (18) for deter-
mining the position of the craft when this has come to
a halt and the passenger bridge or the goods-handling
device is to be connected, and
- a computer system (7, 16) which comprises storage
35   means (9, 17) adapted to store the position of the door
of the craft with respect to a reference point on the
craft and to which are connected the first and the second

position-determining means, said computer system being
adapted to guide, with the aid of information obtained
from the position-determining means (10-13, 18) and the
storage means (9, 17), the positioning means in such a

5   manner that the end of the passenger bridge or the goods-
handling device is connected to the door.

9. A device as claimed in claim 8, c h a r a c -
t e r i s e d in that the storage means (9, 17) further
are adapted to store the expected position of the craft

10 when this has come to a halt and the passenger bridge or
the goods-handling device is to be connected, as well as
the identity of the craft.

10. A device as claimed in claim 8 or 9, c h a r -
a c t e r i s e d in that the second position-determining

15 means (18) comprise means (18) for distance measurement
with the aid of electromagnetic waves.

11. A device as claimed in any one of claims 8-10,
c h a r a c t e r i s e d in that the first position-
determining means comprise a distance-measuring laser

20 device.

12. A device as claimed in any one of claims 8-10,
wherein the passenger bridge is intended for use in
conjunction with aircraft and has a first end portion
(2), a passageway (4) which is pivotable in relation to

25 the first end portion, and a second end portion (5) which
is adapted to be connected to the aircraft and is pivot-
able in relation to the passageway, c h a r a c t e r -
i s e d in that the first position-determining means
comprise a first transducer (10) for determining the

30 angular position of the passageway in relation to the
first end portion, a second transducer (13) for determin-
ing the angular position of the second end portion in
relation to the passageway, a third transducer (11) for
determining the height of the passenger bridge, and a

35 fourth transducer (12) for determining the length of the
passageway.

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13. A device as claimed in any one of claims 8-12, c h a r a c t e r i s e d by at least one pressure trans- ducer (15), which is arranged at the end of the passenger bridge or the goods-handling device and is adapted to

5   measure the pressure exerted on the aircraft by the pas- senger bridge or the goods-handling device.

14. A device as claimed in any one of claims 8-13, c h a r a c t e r i s e d by means (18) which are adapted to check the identity of the craft by interaction there-

10   with.

AIRPORT
DATABASE
i.e. FIDS

17

16

3

2

11

10

12

1

6

4

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7

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14 8

9

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18

19

FIG.I

FIG.2

FIG.3

AIRPORT
DATABASE
i.e. FIDS

17

16

3

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1

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21
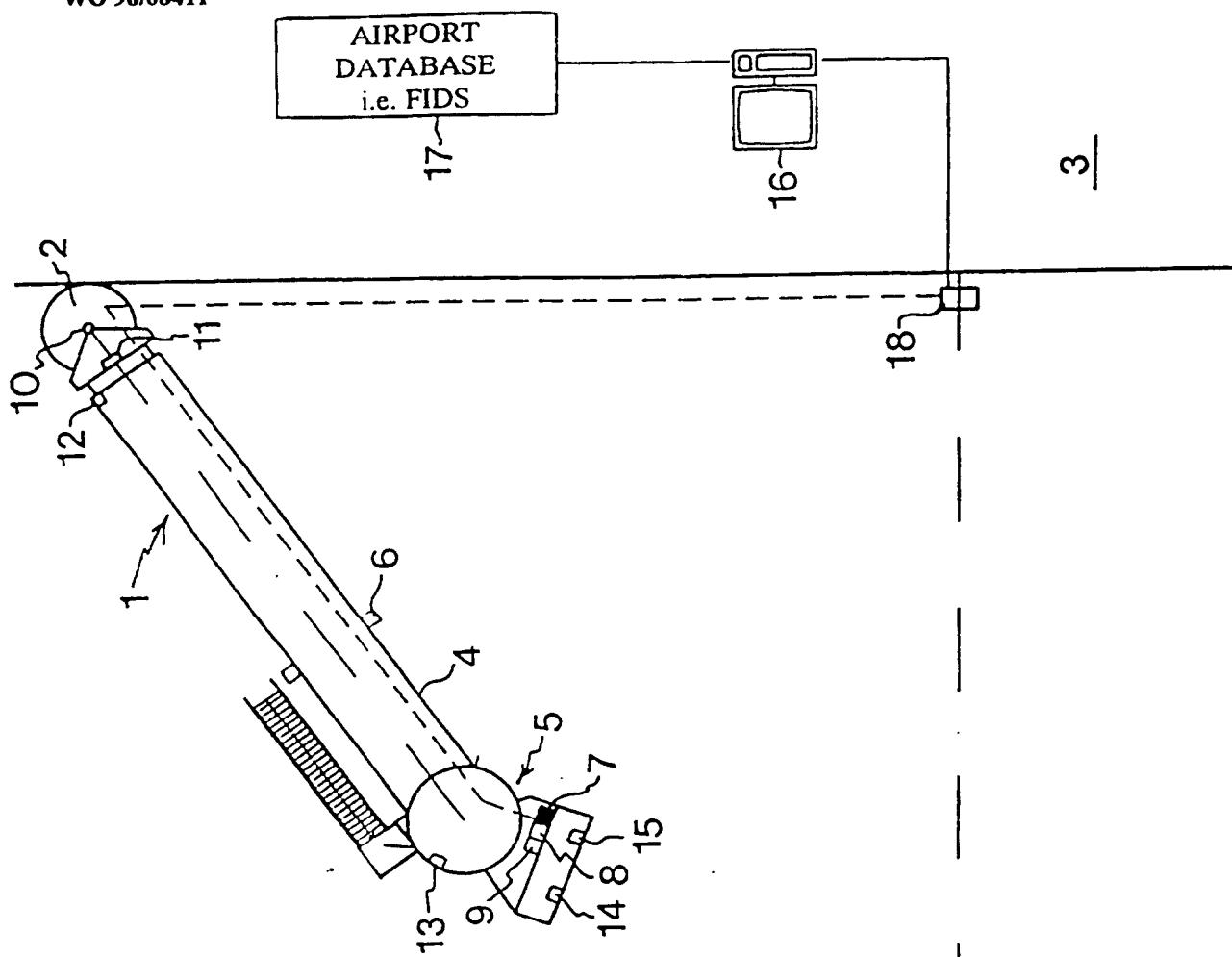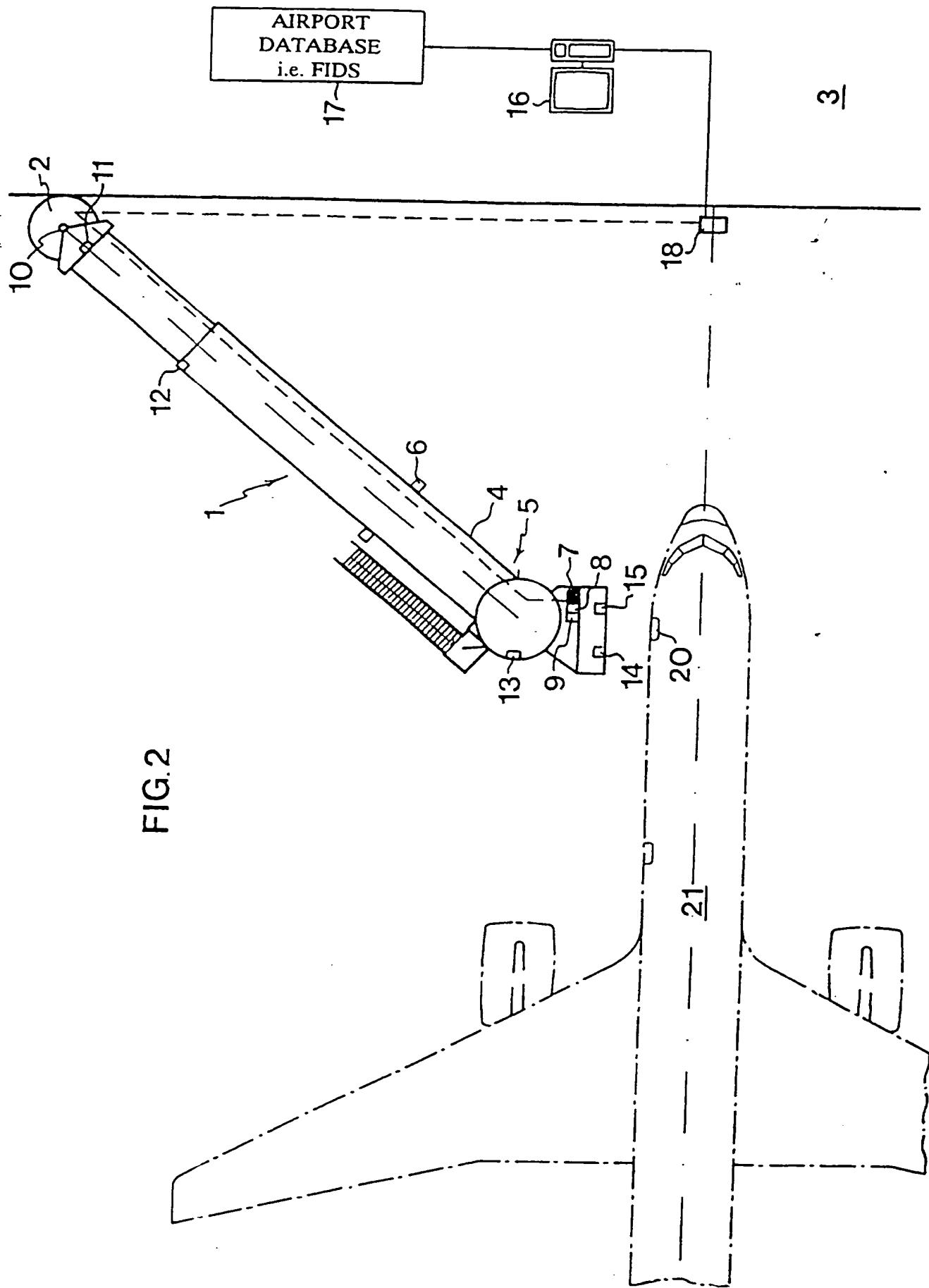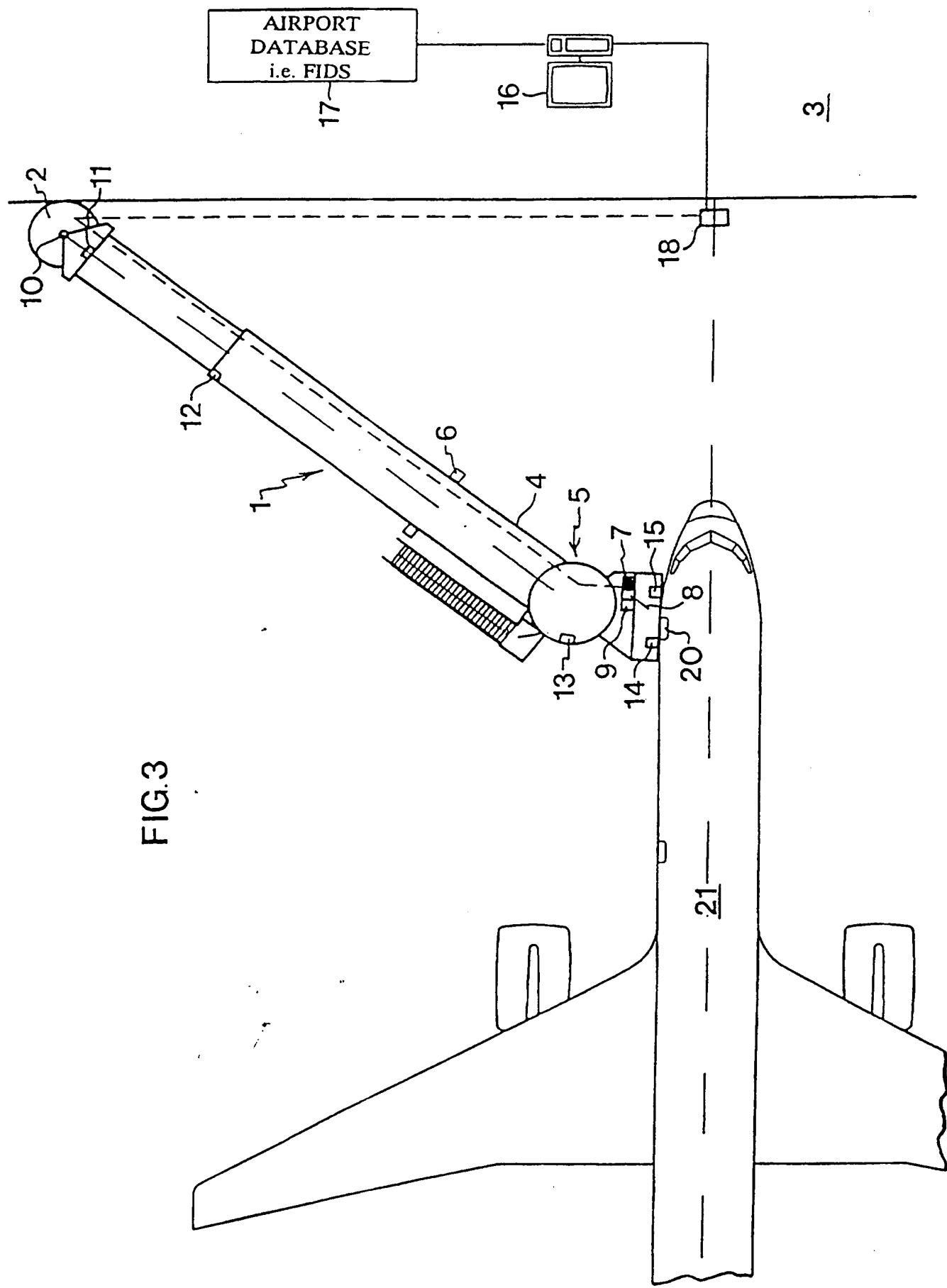
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B64F 1/305

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B64F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3683440 A (XENAKIS ET AL), 15 August 1972 (15.08.72)	1-14

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

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Date of the actual completion of the international search

17 January 1996

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